GHG Mitigation Potential in Global Forests: Deforestation, Transaction Costs, and Alternative Baselines

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Summary and Conclusions

- Deforestation mitigation potential depends on the reference case and carbon price magnitude and path
  - Higher C price early increases share of avoided deforestation and vice versa – early action crediting may provide a clear price signal
  - Africa offers major mitigation potential at low carbon prices –limited discussion to date

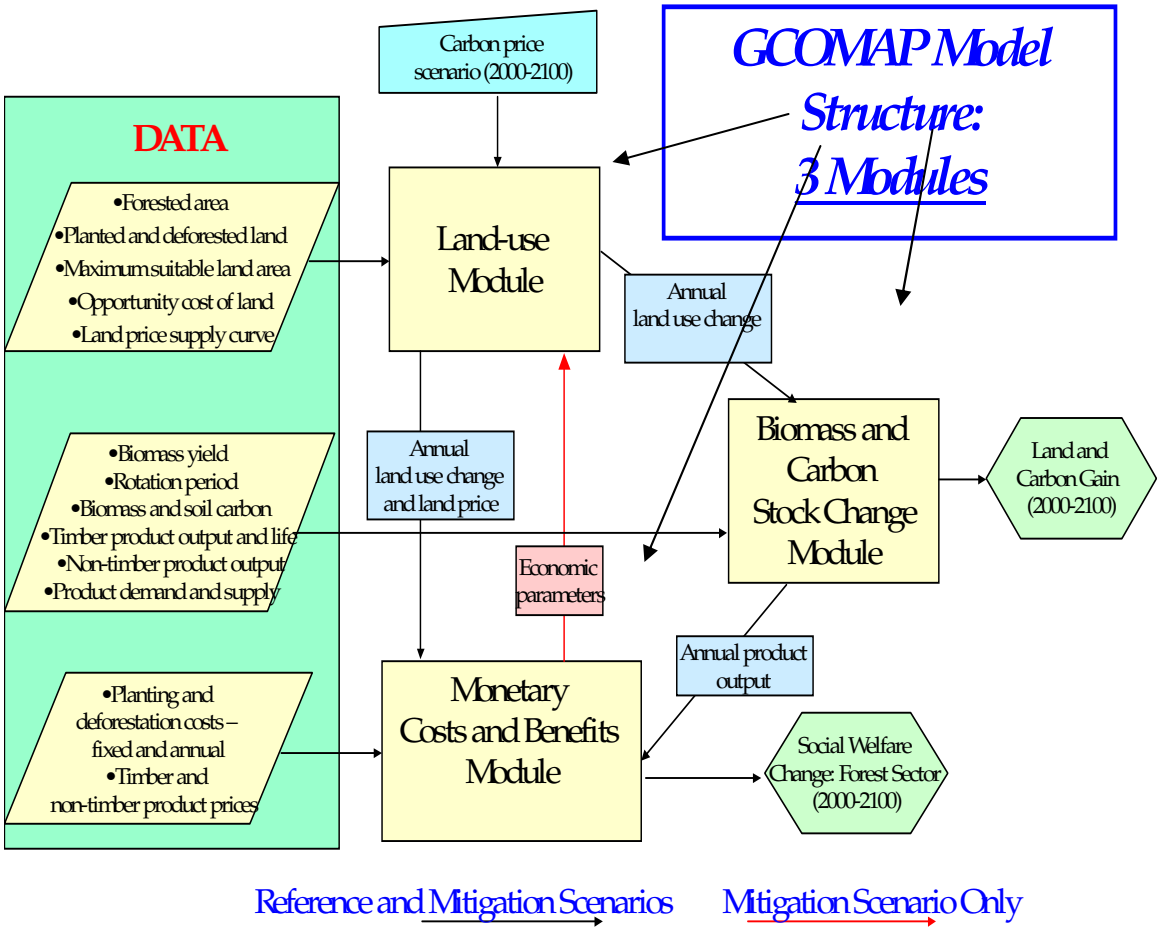
- Studied transaction costs are low (< $2 per t CO2) and significantly affect mitigation potential only at a low carbon price

- Since year-to-year historical and future deforestation rates vary considerably, a probabilistic risk-based analysis of alternative baselines may provide a realistic approach to estimating investment needs and mitigation potential

How much additional land area will be planted or avoided from being deforested in response to C price path?

GCOMAP: A Dynamic Partial Equilibrium Economic Model

- Since 1990, LBNL has developed bottom-up forestry sector models
- GCOMAP was developed using this expertise and data combined with global and OECD data
- Model represents forest sector market dynamics; based on investment theory, and assumes perfect foresight
- Includes 10 regions, a deforestation and 2 forestation options, and tracks carbon in 6 pools annually



Sathaye et al. *The Energy Journal* 2006

Deforestation Rate: Historical and Projected

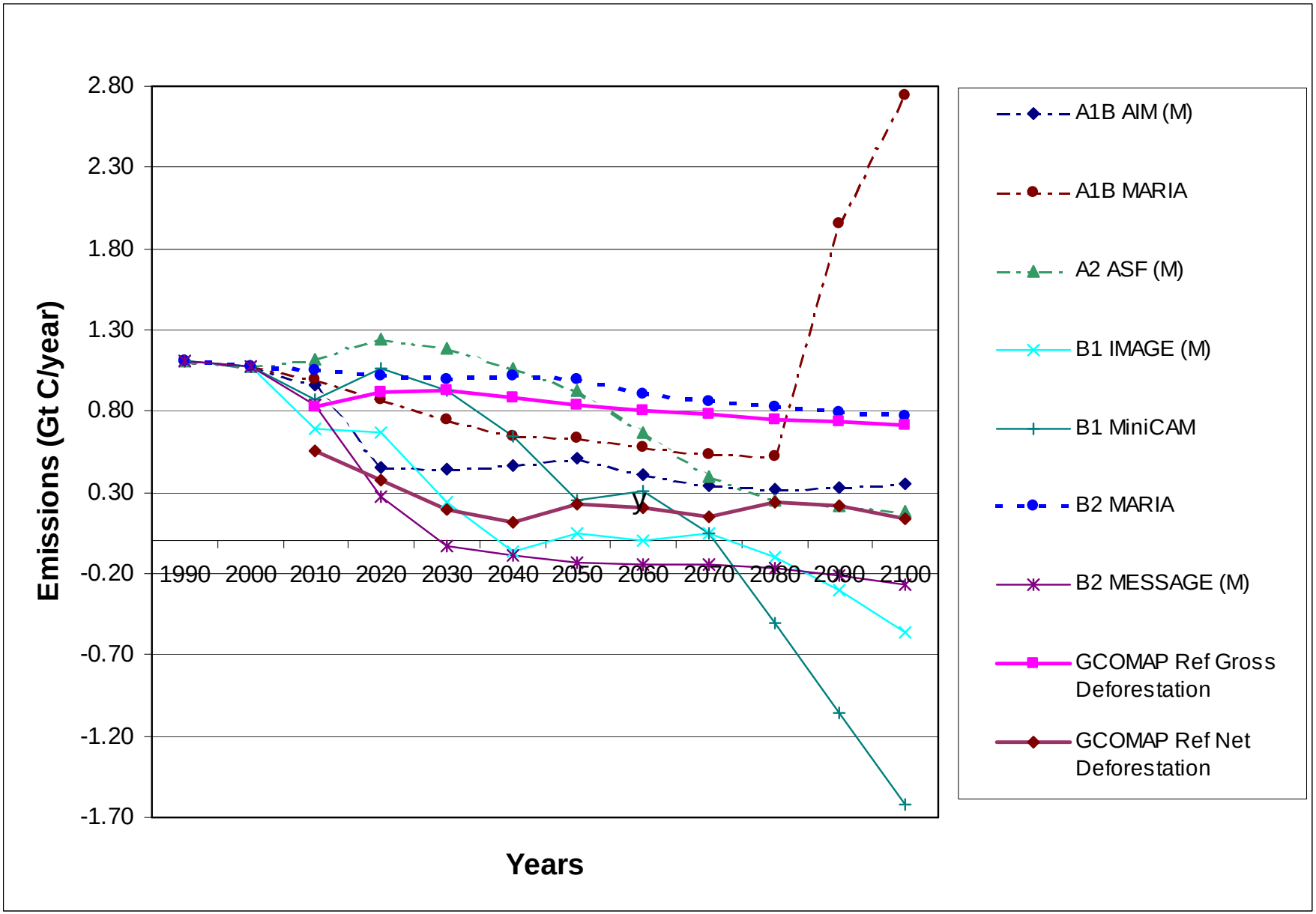
- Global deforestation 17 Mha/yr in 1990s; 13 Mha/yr in 2000-05 (FAO)
  - –India and China: deforestation declined to zero
  - –Brazil: widely fluctuating deforestation rates
  - –Africa 1990-00 deforestation rate increased, unlike in other regions
  - • Deforestation rate is projected to increase to 2020 before declining
- Rest of tropics: Deforestation rates are projected to continue declining

Region	Change in Deforestation Rate (%/yr)	Deforestation Rates (% / year)				
	1990 –00	2000	2020	2040	2050	2100
Africa	+ 0.026	0.80	1.29	0.78	0.65	0.26
Rest of Asia	- 0.005	1.03	0.82	0.60	0.52	0.12
Central America	- 0.011	1.19	0.97	0.75	0.65	0.37
South America	- 0.030	0.40	0.26	0.21	0.20	0.13

The deforestation rate gives the percent decline in the forest area per year
(-) rate is an annual decline in the deforestation rate

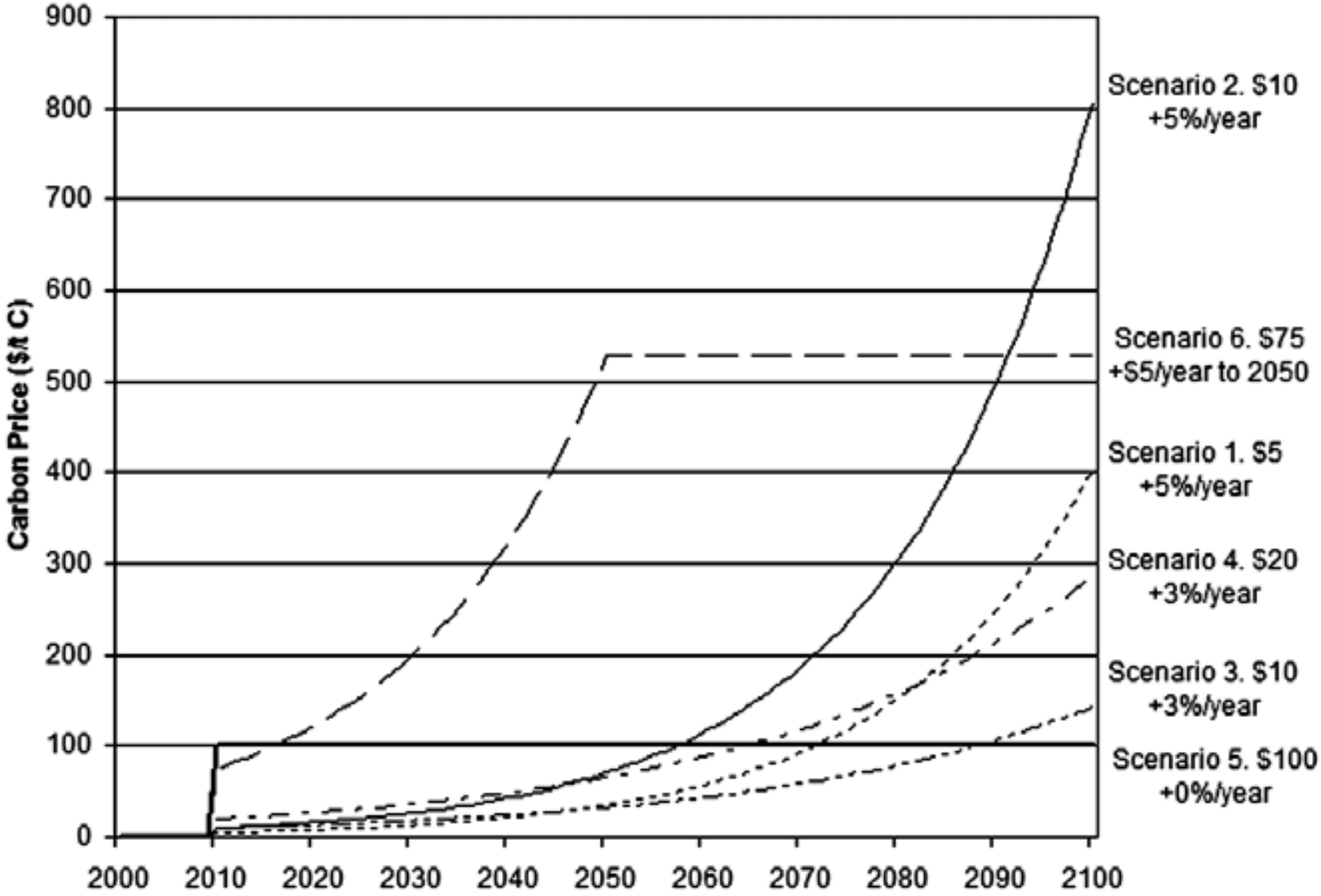
Based on FAO 2001 – Forest Resource Assessment-2000; Kaimovitz 1996 Livestock and deforestation in Central America in 1980s and 1990s; Barraclough and Ghimire 2000. Agricultural Expansion and Tropical Deforestation

Carbon Emissions from Deforestation: Reference Cases (Zero Carbon Price) GCOMAP and IPCC SRES Scenarios (Africa, Asia, Latin America, and the Middle East)

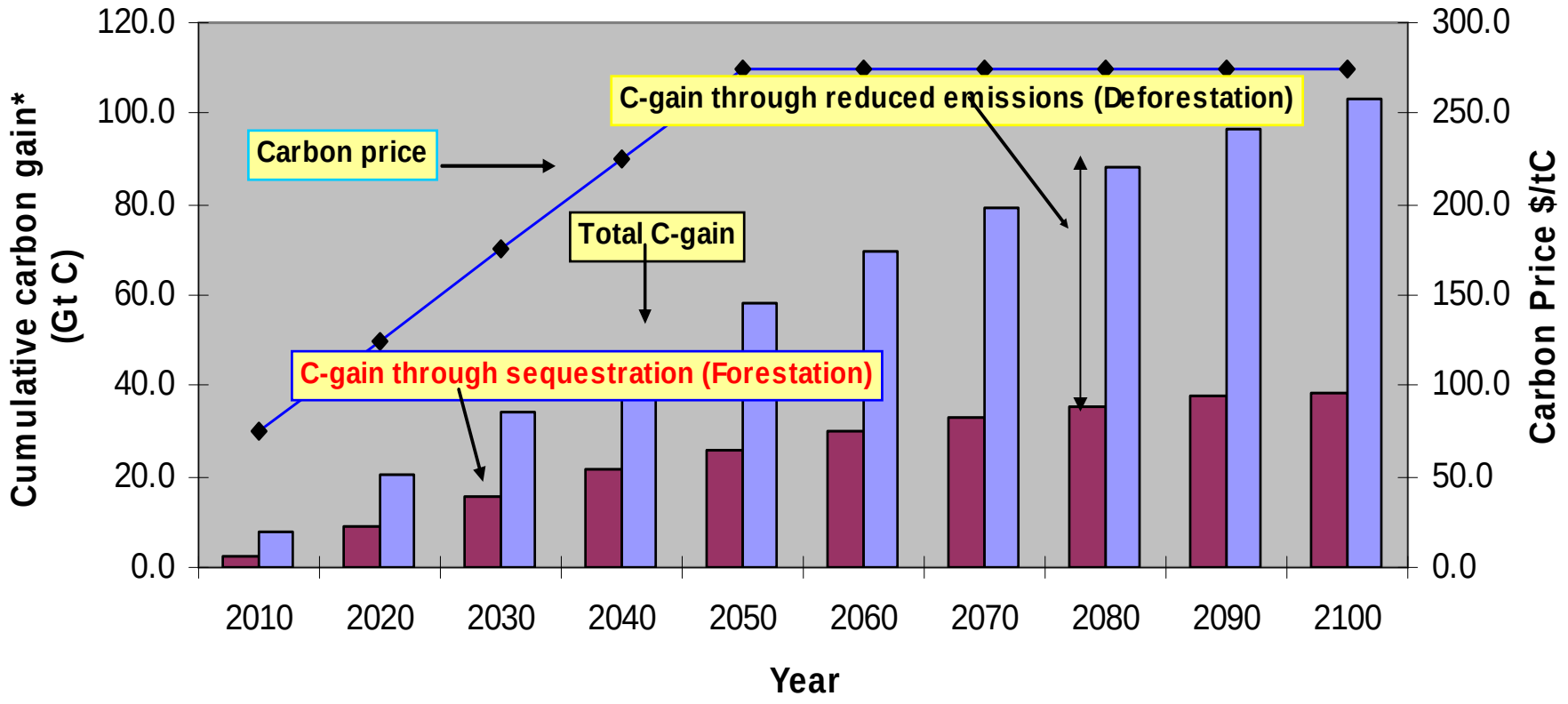


Six Carbon Price Mitigation Scenarios:

Absolute Magnitude and Paths Determine REDD Amount and Timing

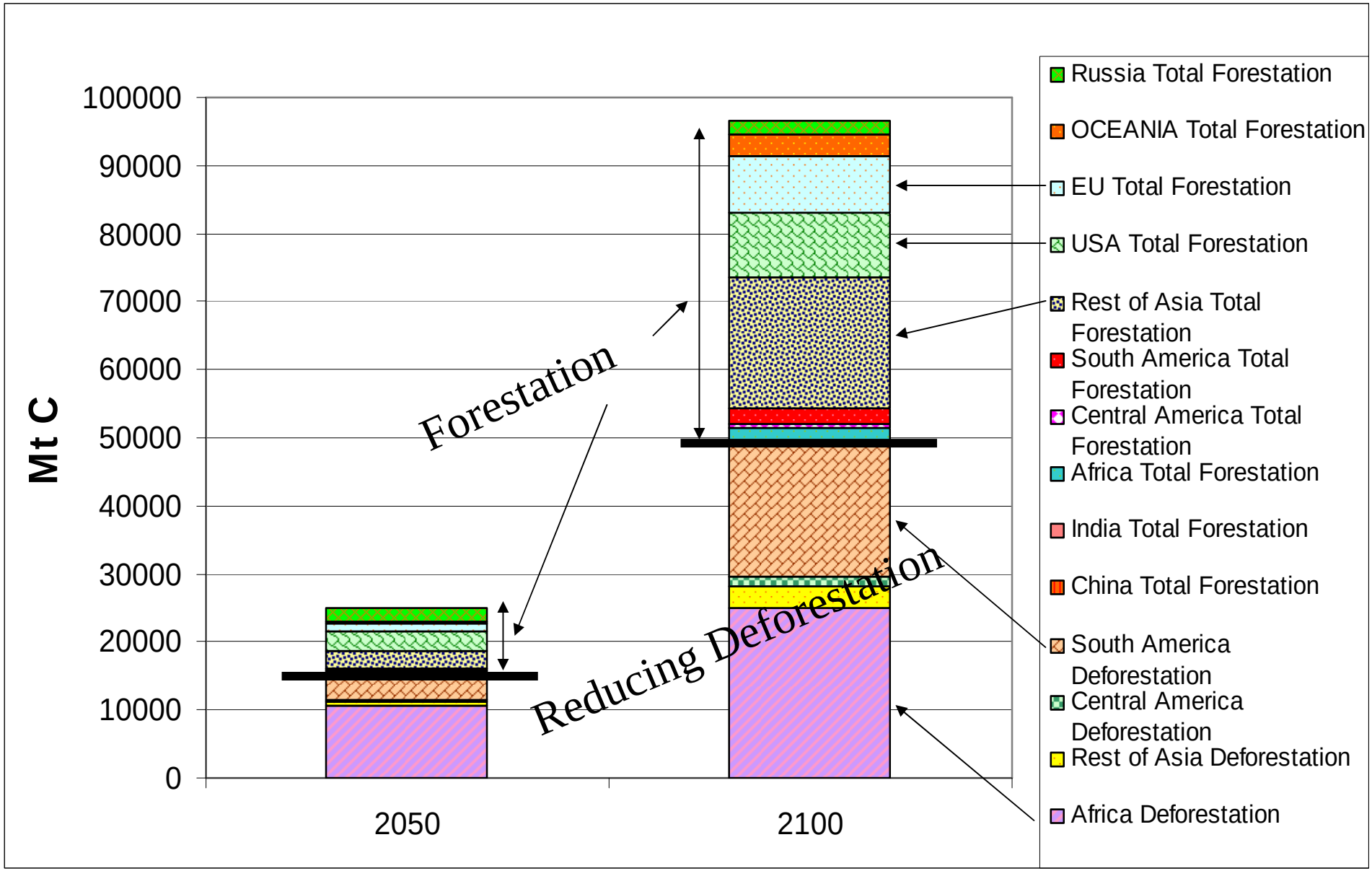


Potential for carbon emissions reduction and sequestration in forestry (Scenario 6: Carbon Price: $75 + $5 / yr; capped at $275 / t C in 2050)



* Carbon gain refers to the cumulative difference between a mitigation and reference scenario by a given year

Scenario 2 ($10+5%/year): Regional Contribution to Carbon Gain in 2050 and 2100

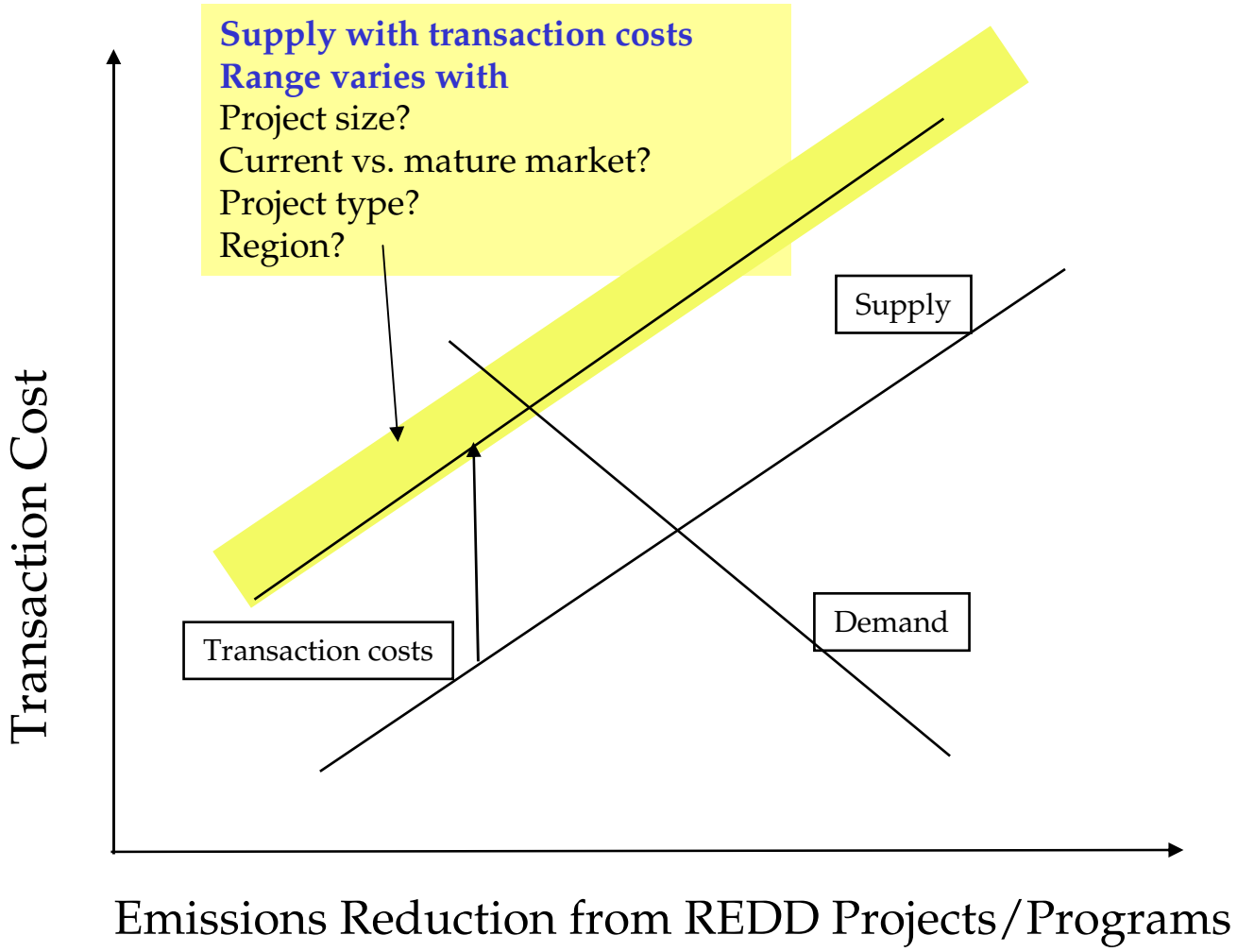


Carbon choke price to theoretically stop deforestation (i.e., C price > opportunity cost) varies across the tropics

- Feasibility of stopping deforestation complicated by many barriers.
- Carbon choke price to halt deforestation depends on opportunity cost of land and products
  - Timber and agricultural products fetch higher prices than land or other products
  - Higher the timber revenue higher the carbon price required to slow or avoid deforestation

Region	Carbon choke price to theoretically stop deforestation ($/ t C)
Africa	$ 39
Central America	$ 127
South America	$ 147
Rest of Asia (Asia without China and India, incl. PNG)	$ 281

Transaction Costs Influence Supply of Traded Carbon



LBNL Study: Transaction Costs Components and Data Sets

- Project search costs – Identification and stakeholder consultation
  - May be spread over many projects
- Feasibility studies costs – engineering, economic, and environmental assessments
- Negotiations costs – obtaining permits, negotiating and enforcing contracts for fuel supply, arranging financing
- Insurance costs – project risk insurance (Difficult to get or too expensive today)
- Regulatory approval costs (GHG)
  - Project validation and government review
- Monitoring and verification costs (GHG) – During project implementation (Spread over many years of project life)

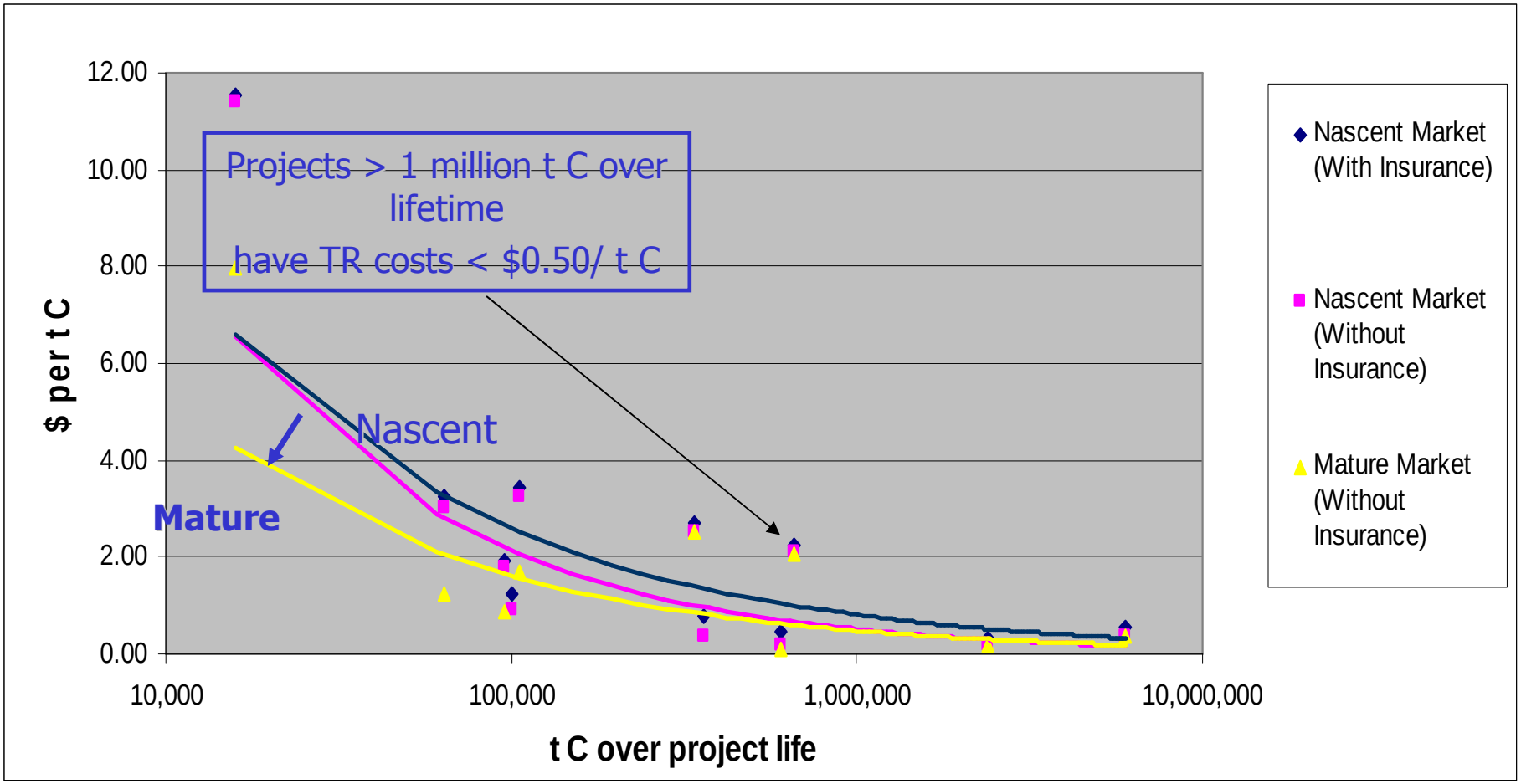
- Data Set 1: (26 projects)
  - The Nature Conservancy (Forestry) -- Bolivia, and Brazil
  - Indian Institute of Science (Forestry) , LBNL (Household woodstoves)
  - Oregon Climate Trust (Forestry, energy efficiency, renewable energy)
  - Natural Resources Canada (Forestry)
  - Trexler and Associates (Methane, large power plants, energy efficiency, carbon capture)
- Data Set 2: (13 projects)
  - Ecofys (renewable energy)
  - Ecoenergy (bagasse cogeneration)
- Data Set 3: (50 projects) –
  - Swedish AIJ Programme (Energy efficiency and renewable energy)
- Data Set 4: (10 projects)
  - Global Environmental Facility (Transportation, energy efficiency, renewable energy)

Source: Antinori and Sathaye (2007)

Study Findings:

1) Transaction Costs (average) Decline with Project Size in C Tonnes.

2) Mature Scenario Costs < Nascent Market.

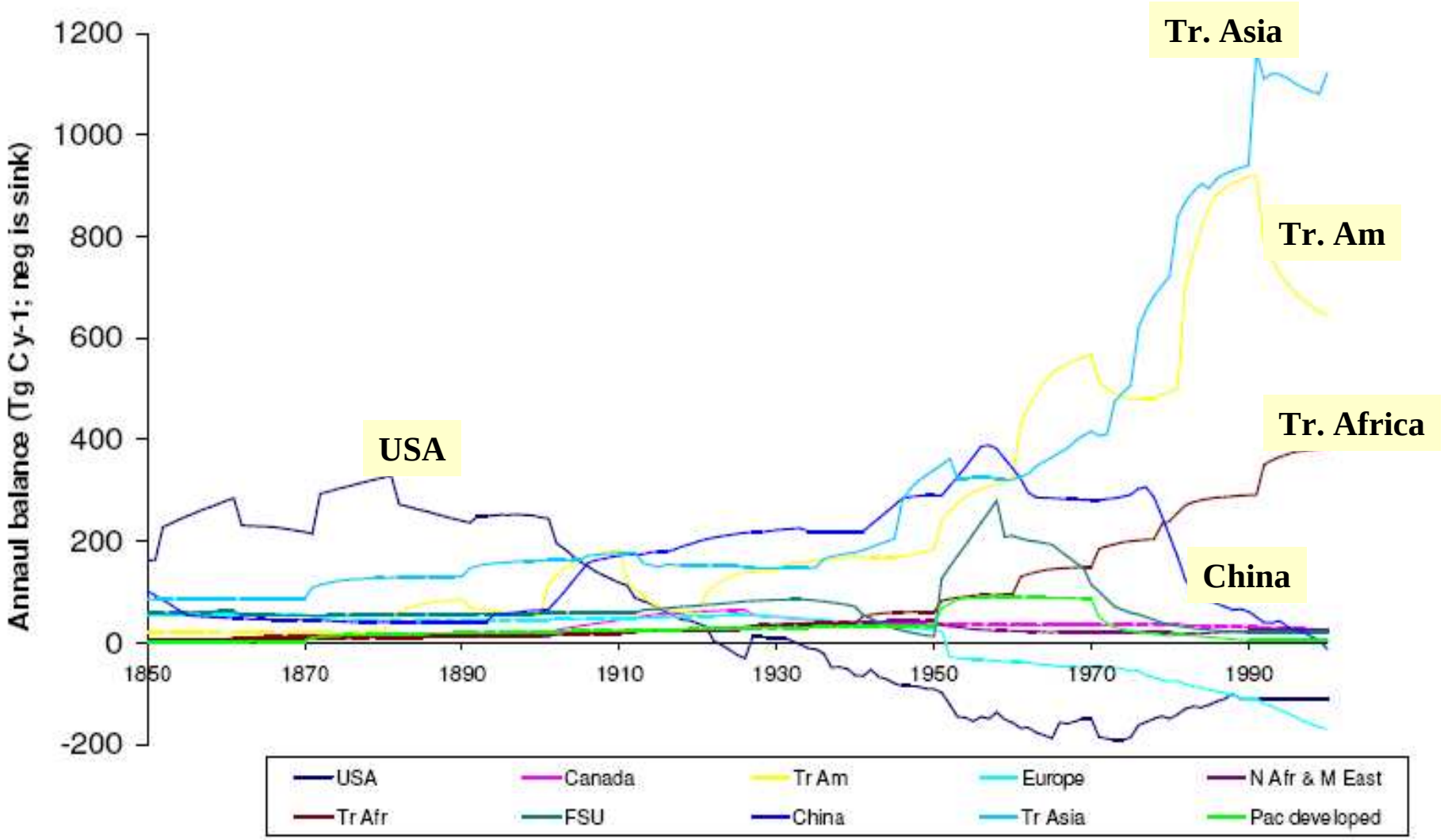


Findings: Transaction Costs Forestry Projects

- Project sizes range from 0.06 to 22.0 million t CO2 over project life
- Transaction costs range from
  - $0.09/t CO2 for large projects to $1.2/t CO2 for smaller ones
  - 1% to 19% of project costs for forestry projects
- Implications
  - Programmatic approaches and large scale projects are to be preferred
  - Relative to carbon prices to date transaction costs of projects are small
  - Forestry carbon mitigation potential is not likely to be significantly reduced by transaction costs

Source: Antinori and Sathaye (2007)

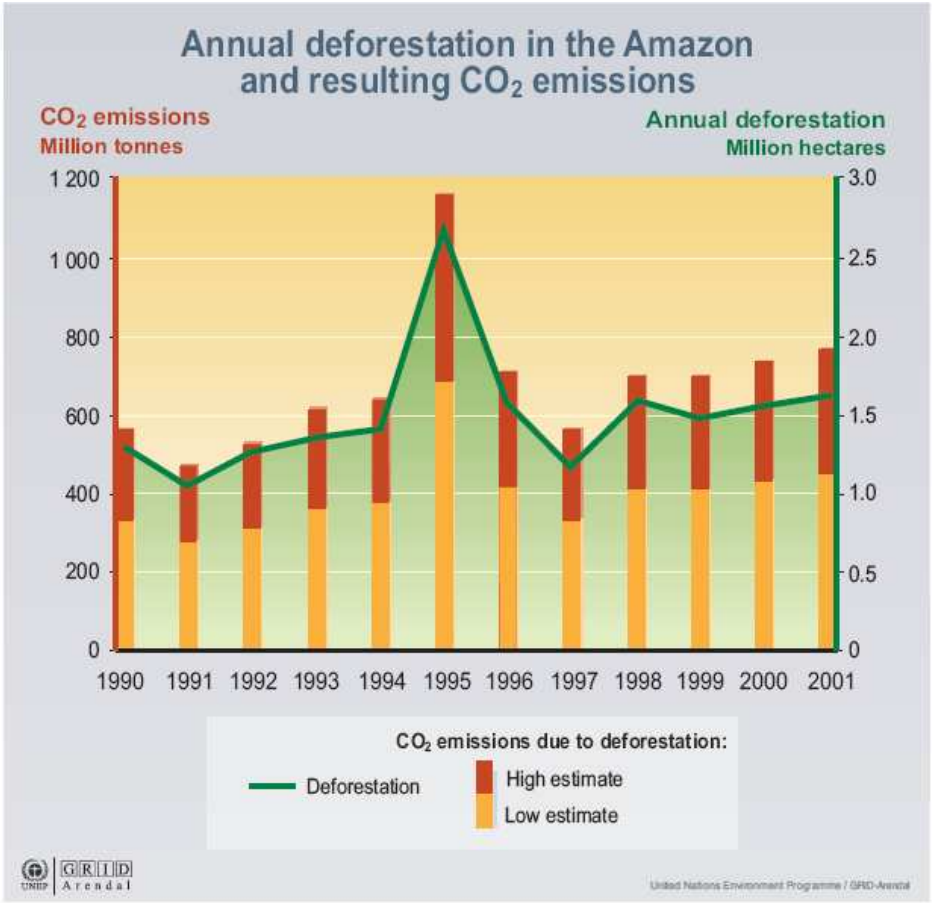
Baseline Setting: Carbon balance of the land use change and forestry sector by region (Positive Values = Emissions)



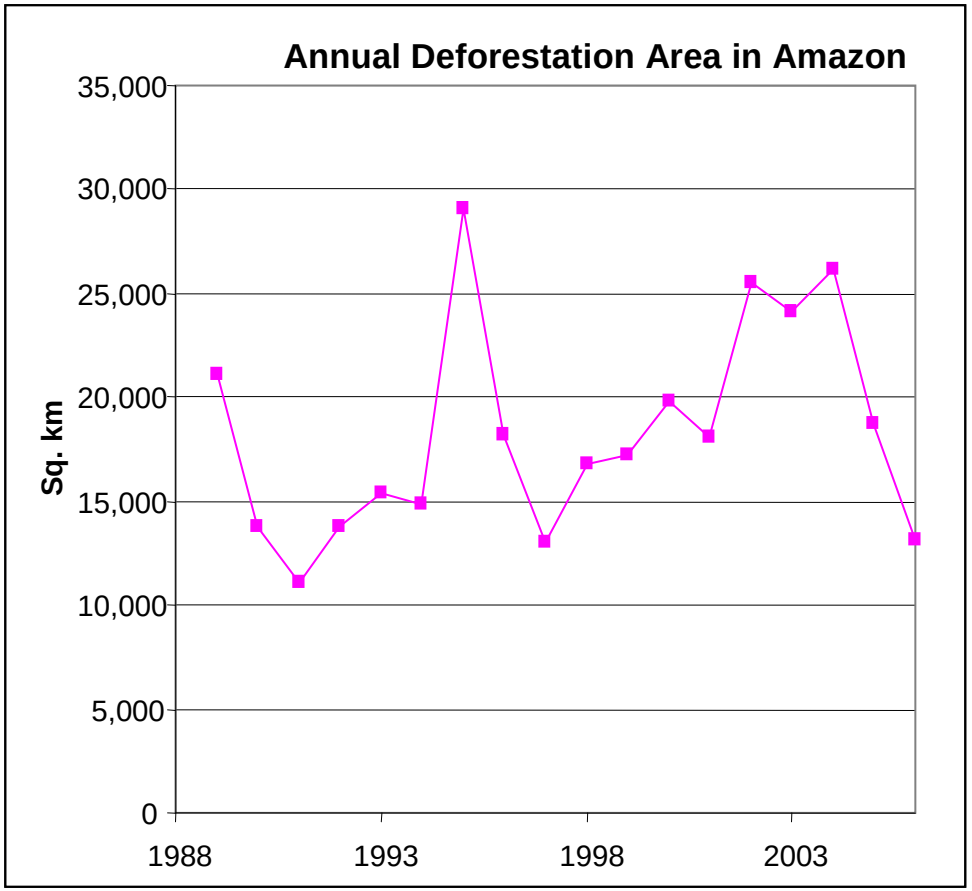
Source: Houghton (2003)

Baseline Setting:
How to model sharp fluctuations in base year deforested area?

Brazil Example

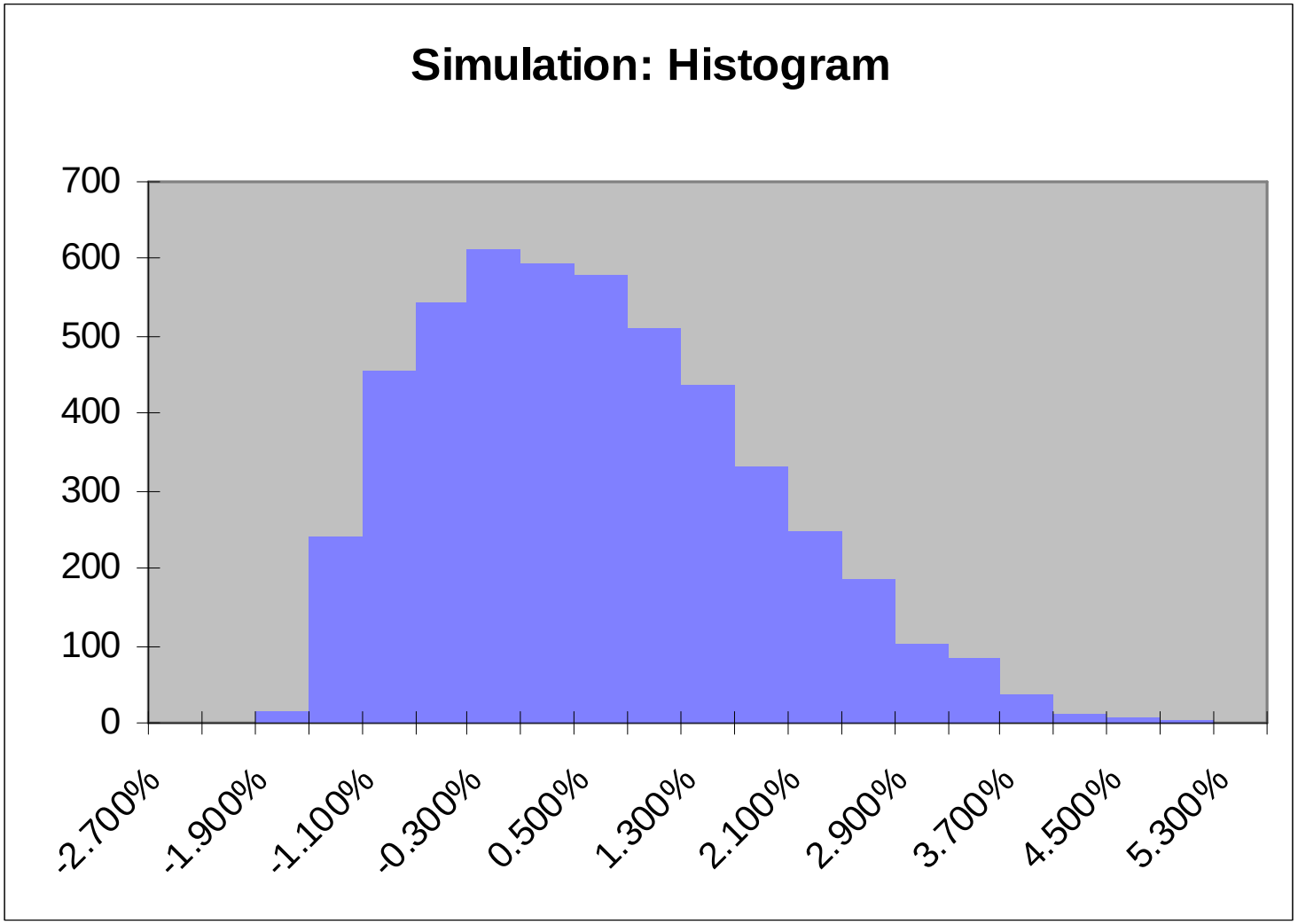


Sources: UNEP 1999; La Rovere 2000; Cramer 2004.



Source: INPE, Brazil

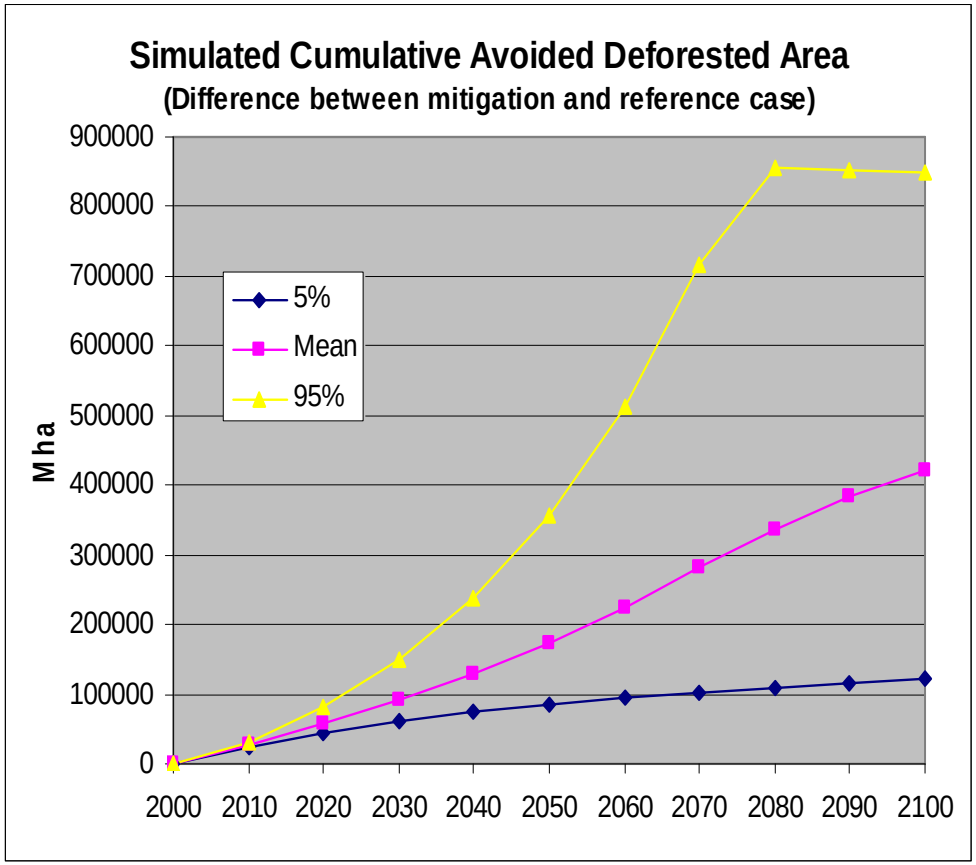
Monte Carlo Simulation Analysis: Deforestation Rates 10 Year Averages Based on Brazil Data

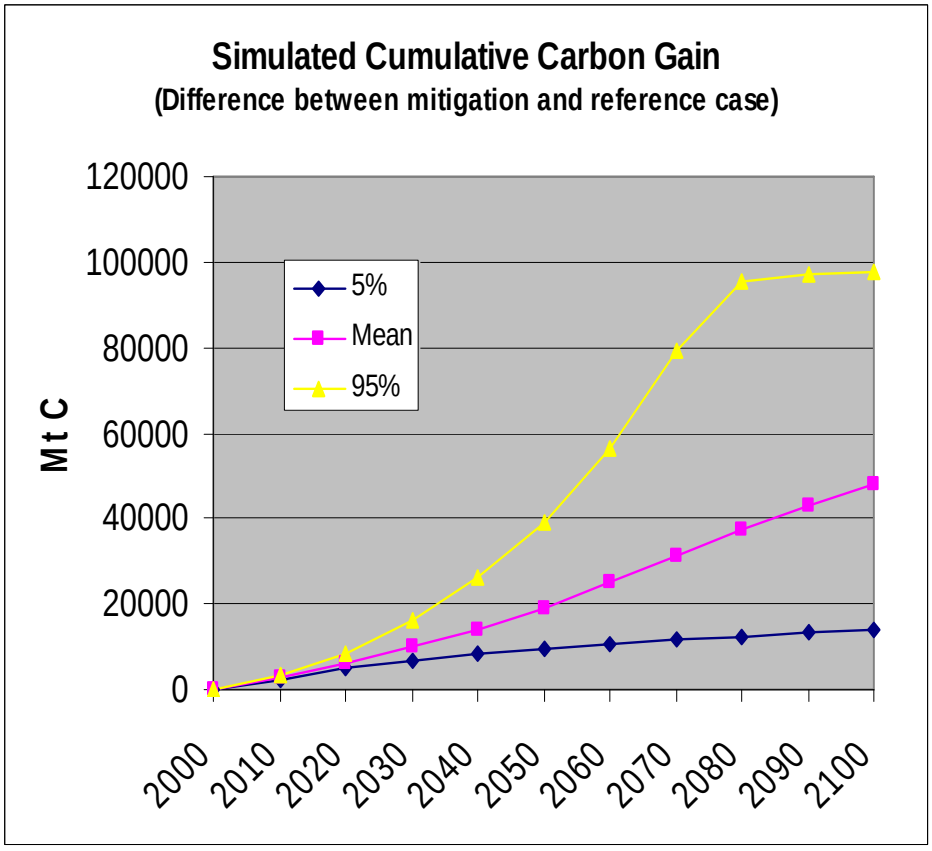


Monte Carlo Analysis of Alternative Reference Cases: South America Deforested Area and Forest Carbon Stock

Constant carbon price: $100/t C (2000-2100)

Annual deforestation rate – Probabilistic values based on histogram





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